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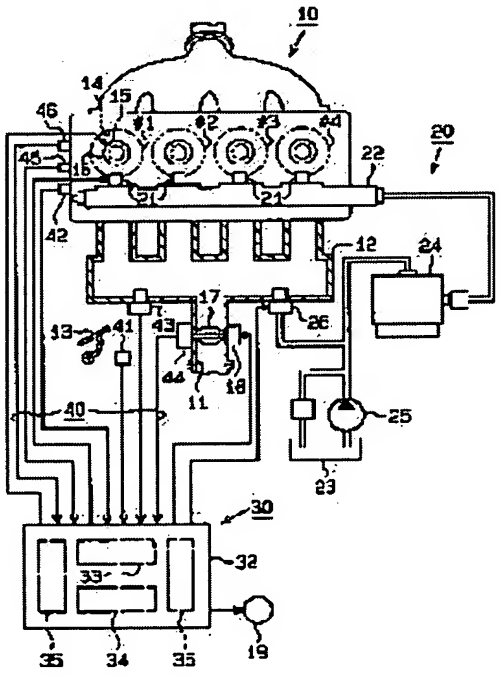
(54) FUEL INJECTION CONTROL UNIT FOR IN-CYLINDER INJECTION TYPE SPARK IGNITION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a fuel injection control unit for an in-cylinder injection type spark ignition engine free from back fire.
SOLUTION: An engine 10 is provided with a main fuel injection valve 21 for injecting fuel directly into a combustion chamber 14 and an auxiliary fuel injection valve 26 for injecting fuel into a surge tank 12 comprising an intake passage 11. When the engine starts and temperature of cooling water is at a prescribed degree or less, fuel is injected from the auxiliary fuel injection valve 26 as well as from the main fuel injection valve 21. An electronic control device 32 prohibits fuel injection from the auxiliary fuel injection valve 26 and increases the fuel injection volume from the main fuel injection valve 21 when the engine started and a throttle valve opening is at prescribed degree or more.



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CLAIMS

[Claim(s)]

[Claim 1] The fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder characterized by to supervise the Lean-ized degree of the combustion air-fuel ratio in said engine combustion chamber, and to restrict the fuel oil consumption of said auxiliary fuel injection valve based on this RIN-ized degree in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel to an engine combustion chamber, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting.

[Claim 2] The fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder characterized by to have an auxiliary fuel-injection prohibition means forbid the fuel injection of said auxiliary fuel injection valve when the opening of a throttle valve which adjusts the amount of the inhalation air introduced into an engine combustion chamber in said engine combustion chamber in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting is large than predetermined opening.

[Claim 3] The fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder characterized by having further a main-fuel injection prohibition means to forbid the fuel injection of said main-fuel injection valve in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 2 when the fuel injection of said auxiliary fuel injection valve is forbidden by said auxiliary fuel-injection prohibition means.

[Claim 4] The fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder characterized by having further a main-fuel injection increase-in-quantity means to increase the quantity of the fuel oil consumption of said main-fuel injection valve in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 2 when the fuel injection of said auxiliary fuel injection valve is forbidden by said auxiliary fuel-injection prohibition means.

[Claim 5] The fuel-injection control device of the injection type jump-spark-ignition

internal combustion engine in a cylinder characterized by to have an auxiliary fuel-injection loss-in-quantity means decrease the quantity of the fuel oil consumption of said auxiliary fuel injection valve when the opening of a throttle valve which adjusts the amount of the inhalation air introduced into an engine combustion chamber in said engine combustion chamber in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting is large than predetermined opening.

[Claim 6] The fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder characterized by having further a main-fuel injection increase-in-quantity means to increase the quantity of the fuel oil consumption of said main-fuel injection valve in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 5 when the quantity of the fuel oil consumption of said auxiliary fuel injection valve is decreased by said auxiliary fuel-injection loss-in-quantity means.

[Claim 7] It is the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder which said auxiliary fuel-injection loss-in-quantity means sets up greatly the loss-in-quantity degree of the fuel oil consumption of said auxiliary fuel injection valve in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 6, so that the opening of said throttle valve becomes large, and is characterized by for said main-fuel injection increase-in-quantity means to set up the increase-in-quantity degree of the fuel oil consumption of said main-fuel injection valve according to the loss-in-quantity degree of the fuel oil consumption of said auxiliary fuel injection valve.

[Claim 8] The fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder characterized by to have an auxiliary fuel-injection loss-in-quantity means decrease greatly the quantity of the fuel oil consumption of said auxiliary fuel injection valve, so that the opening of a throttle valve which adjusts the amount of the inhalation air introduced into an engine combustion chamber in said engine combustion chamber in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting becomes large.

[Claim 9] The fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder characterized by having further a main-fuel injection increase-in-quantity means to increase greatly the quantity of the fuel oil consumption of said main-fuel injection valve, so that the loss-in-quantity degree at the time of decreasing the quantity of the fuel oil consumption of said auxiliary fuel injection valve with said auxiliary fuel-injection loss-in-quantity means becomes large in the fuel-injection control

unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 8.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel to an engine combustion chamber, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting.

[0002]

[Description of the Prior Art] In addition to the main-fuel injection valve for the injection in a cylinder, in the jump-spark-ignition-type internal combustion engine which injected the fuel directly into the engine combustion chamber (inside of a cylinder), the thing equipped with the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path is known conventionally (for example, refer to JP,10-18884,A and JP,10-176574,A). He is trying to secure good engine startability in such an internal combustion engine at the time between the colds by injecting some fuels required for engine starting from an auxiliary fuel injection valve, and making this introduce into an engine combustion chamber, after making it fully mix with the flowing inhalation air and making the inside of an inhalation-of-air path evaporate.

[0003]

[Problem(s) to be Solved by the Invention] By the way, although high pressure is pressurized using high pressure pumping of an engine drive type and he is trying to supply a fuel to a fuel injection valve in the internal combustion engine of the injection type in a cylinder, at the time of engine starting, pressurization of the fuel by this high pressure pumping is not performed, or since that pressurization becomes less enough, fuel injection pressure falls and the particle size of the fuel spray becomes large. For this reason, the rate of the fuel which adheres to the crowning of an engine piston or the wall of an engine combustion chamber among the fuels injected by the engine combustion chamber from a main-fuel injection valve comes to increase. Furthermore, like [at the time of starting between the colds], since evaporation of the fuel spray is hard to be promoted when the temperature of an engine combustion chamber is low, diffusion of the fuel in this combustion chamber becomes inadequate.

[0004] consequently, actual combustion ceases to be presented only with the part of the fuels supplied to an engine combustion chamber from a main-fuel injection valve and an auxiliary fuel injection valve, and a combustion air-fuel ratio (ratio of the amount of the inhalation air introduced into an engine combustion chamber to the amount of the fuel with which combustion is actually presented) Lean-izes it -- it becomes like (it increases).

When the amount of the inhalation air introduced into an engine combustion chamber with increase of throttle opening etc. increases, the Lean-ized degree of such a combustion air-fuel ratio also becomes still larger.

[0005] And if a combustion air-fuel ratio Lean-izes in this way, since combustion will become slow, a period after gaseous mixture is lit until the combustion is completed comes to increase. Consequently, when combustion was continued till the valve-opening stage of an intake valve and this bulb opened, there was a possibility of lighting the gaseous mixture in the inhalation-of-air path in which the flame which remained in the engine combustion chamber was formed of the fuel injection of an auxiliary fuel injection valve. Generally such a phenomenon is called a blowback and serves as a cause to which the endurance of inhalation-of-air system components, such as an inlet pipe, is reduced.

[0006] This invention is made in view of such the actual condition, and that purpose is in offering the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which can control generating of a blowback.

[0007]

[Means for Solving the Problem] The means and its operation effectiveness for attaining the above-mentioned purpose are indicated below. He supervises the Lean-ized degree of the combustion air-fuel ratio in said engine combustion chamber, and is trying to restrict the fuel oil consumption of said auxiliary fuel injection valve in invention indicated to claim 1 based on this RIN-ized degree in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel to an engine combustion chamber, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting.

[0008] According to the above-mentioned configuration, the Lean-ized degree of a combustion air-fuel ratio is large, and when combustion of the gaseous mixture of an engine combustion chamber becomes slow, generating of a blowback can be controlled by restricting the fuel oil consumption of this valve, such as suspending the fuel injection of an auxiliary fuel injection valve, or decreasing the quantity of the fuel oil consumption.

[0009] In addition, the above-mentioned combustion air-fuel ratio is a ratio of the amount of the inhalation air introduced into an engine combustion chamber to the amount of the fuel with which combustion is actually presented among the fuels injected from the main-fuel injection valve and the auxiliary fuel injection valve, and the Lean-ized degree can be supervised based on for example, an inhalation air content, the temperature of the engine combustion chamber presumed from whenever [engine cooling water temperature], etc.

[0010] When the opening of a throttle valve which adjusts the amount of the inhalation air introduced into an engine combustion chamber in said engine combustion chamber in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of

engine starting is large than predetermined opening, he is trying to have an auxiliary fuel-injection prohibition means forbid the fuel injection of said auxiliary fuel injection valve, in invention which indicated to claim 2.

[0011] According to the above-mentioned configuration, since the fuel injection of an auxiliary fuel injection valve is forbidden when the opening of a throttle valve is larger than predetermined opening, gaseous mixture is not generated in an inhalation-of-air path, but only inhalation air comes to flow this path to it. Therefore, also in the condition that the Lean-ized degree of a combustion air-fuel ratio became large with increase in quantity of an inhalation air content, and combustion of the gaseous mixture of an engine combustion chamber became slow, generating of a blowback can be certainly controlled now.

[0012] By the way, if the fuel injection of an auxiliary fuel injection valve is forbidden in this way, as a result of engine startability's falling, starting is not completed, but it may adhere to the wall surface of an engine combustion chamber, with the fuel not burned injected from the main-fuel injection valve. For this reason, when redoing starting, the combustion air-fuel ratio of an engine combustion chamber becomes rich too much by evaporation of the fuel which adhered to the wall surface of an engine combustion chamber at the time of the last starting, and there is a possibility of worsening the engine startability at the time of starting of such redo.

[0013] Then, when the fuel injection of said auxiliary fuel injection valve is forbidden by said auxiliary fuel-injection prohibition means, he is trying to have further a main-fuel injection prohibition means to forbid the fuel injection of said main-fuel injection valve, in invention indicated to claim 3 in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 2.

[0014] According to the above-mentioned configuration, it can add to the operation effectiveness of invention indicated to claim 2, and aggravation of the engine startability at the time of starting of the above redo can be controlled now.

[0015] When the fuel injection of said auxiliary fuel injection valve is forbidden by said auxiliary fuel-injection prohibition means, he is trying to equip further invention indicated to claim 4 with a main-fuel injection increase-in-quantity means to increase the quantity of the fuel oil consumption of said main-fuel injection valve, in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 2.

[0016] According to the above-mentioned configuration, in addition to the operation effectiveness of invention indicated to claim 2, aggravation of the engine startability accompanying the fuel injection of an auxiliary fuel injection valve being forbidden can be controlled now.

[0017] When the opening of a throttle valve which adjusts the amount of the inhalation air introduced into an engine combustion chamber in said engine combustion chamber in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel, and the

auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting is large than predetermined opening, he is trying to have an auxiliary fuel-injection loss-in-quantity means decrease the quantity of the fuel oil consumption of said auxiliary fuel injection valve, in invention which indicated to claim 5.

[0018] According to the above-mentioned configuration, since the quantity of the fuel oil consumption of an auxiliary fuel injection valve is decreased when the opening of a throttle valve is larger than predetermined opening, the fuel concentration of the gaseous mixture generated in an inhalation-of-air path comes to be stopped low. Therefore, also in the condition that the Lean-ized degree of a combustion air-fuel ratio became large with increase in quantity of an inhalation air content, and combustion of the gaseous mixture of an engine combustion chamber became slow, the flame of an engine combustion chamber stops easily being able to light the gaseous mixture in an inhalation-of-air path, and can control generating of a blowback now.

[0019] When the quantity of the fuel oil consumption of said auxiliary fuel injection valve is decreased by said auxiliary fuel-injection loss-in-quantity means, he is trying to have further a main-fuel injection increase-in-quantity means to increase the quantity of the fuel oil consumption of said main-fuel injection valve, in invention indicated to claim 6 in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 5.

[0020] According to the above-mentioned configuration, in addition to the operation effectiveness of invention indicated to claim 5, aggravation of the engine startability accompanying the quantity of the fuel oil consumption of an auxiliary fuel injection valve being decreased can be controlled now.

[0021] Said auxiliary fuel-injection loss-in-quantity means sets up greatly the loss-in-quantity degree of the fuel oil consumption of said auxiliary fuel injection valve, so that the opening of said throttle valve becomes large, and he is trying, as for said main-fuel injection increase-in-quantity means, to set up the increase-in-quantity degree of the fuel oil consumption of said main-fuel injection valve in invention indicated to claim 7 according to the loss-in-quantity degree of the fuel oil consumption of said auxiliary fuel injection valve in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 6.

[0022] the operation effectiveness of invention which be indicated to claim 6 according to the above-mentioned configuration -- in addition --, so that the Lean-ized degree of a combustion air-fuel ratio become large and the rate of combustion of the gaseous mixture of an engine combustion chamber fall with increase of the amount of the inhalation air introduce into an engine combustion chamber (i.e., so that the flame of an engine combustion chamber will be in the condition be easy to light the gaseous mixture in an inhalation of air path) -- said -- the fuel concentration of gaseous mixture come be stop low. Moreover, since the increase-in-quantity degree of the fuel oil consumption of a main-fuel injection valve is set up according to the loss-in-quantity degree of the fuel oil consumption of such an auxiliary fuel injection valve, the fall of the engine startability accompanying

loss in quantity of the fuel oil consumption of an auxiliary fuel injection valve comes to be suitably compensated by increase in quantity of the fuel oil consumption of a main-fuel injection valve. Therefore, according to the above-mentioned configuration, generating of a blowback and aggravation of engine startability can be appropriately controlled now, respectively.

[0023] He is trying to have an auxiliary fuel-injection loss-in-quantity means decrease greatly the quantity of the fuel oil consumption of said auxiliary fuel injection valve, in invention which indicated to claim 8, so that the opening of a throttle valve which adjusts the amount of the inhalation air introduced into an engine combustion chamber in said engine combustion chamber in the fuel-injection control device of the injection type jump-spark-ignition internal combustion engine in a cylinder having the main-fuel injection valve which injects a fuel, and the auxiliary fuel injection valve which injects a fuel in an inhalation-of-air path at the time of engine starting becomes large.

[0024] so that according to the above-mentioned configuration the Lean-ized degree of a combustion air-fuel ratio becomes large and the rate of combustion of the gaseous mixture of an engine combustion chamber falls with increase of the amount of the inhalation air introduced into an engine combustion chamber (i.e., so that the flame of an engine combustion chamber will be in the condition of being easy to light the gaseous mixture in an inhalation-of-air path) -- said -- the fuel concentration of gaseous mixture comes to be stopped low. Therefore, generating of a blowback can be suitably controlled now.

[0025] He is trying to have further a main-fuel injection increase-in-quantity means to increase greatly the quantity of the fuel oil consumption of said main-fuel injection valve, in invention indicated to claim 9 in the fuel-injection control unit of the injection type jump-spark-ignition internal combustion engine in a cylinder which indicated to claim 8, so that the loss-in-quantity degree at the time of decreasing the quantity of the fuel oil consumption of said auxiliary fuel injection valve with said auxiliary fuel-injection loss-in-quantity means becomes large.

[0026] According to the above-mentioned configuration, in addition to the operation effectiveness of invention indicated to claim 8, aggravation of the engine startability accompanying loss in quantity of the fuel oil consumption of an auxiliary fuel injection valve can be suitably controlled now by increase in quantity of the fuel oil consumption of a main-fuel injection valve.

[0027]

[Embodiment of the Invention] The 1st operation gestalt which applied this invention to the fuel-injection control unit of the injection type gasoline engine in a cylinder is explained below [the 1st operation gestalt].

[0028] Drawing 1 shows the outline configuration of the fuel-injection control unit in this operation gestalt. This fuel-injection control device becomes an engine 10 from the control system 30 and the various sensors which control the fuel-supply system 20 which carries out injection supply of the fuel, the fuel injection by this fuel-supply system 20, etc., is equipped with the detection system 40 which outputs the detecting signal from these

sensors to a control system 30 as some control data, and is constituted.

[0029] It is prepared corresponding to gas column #1-#4. the fuel-supply system 20 of a fuel-injection control device -- an engine 10 -- each -- In the these gas column #1 - # combustion chamber 14 of 4, a fuel A fuel is directly supplied from the supply pump 24 which supplies the fuel in a fuel tank 23 and a feed pump 25, and this feed pump 25 to the main-fuel injection valve 21 injected directly, the delivery pipe 22 which carries out distribution supply of the fuel at this main-fuel injection valve 21, and this delivery pipe 22. It has the auxiliary fuel injection valve 26 which injects a fuel in the surge tank 12 which constitutes a part of inhalation-of-air path 11.

[0030] the main-fuel injection valve 21 and the auxiliary fuel injection valve 26 -- each -- that interior -- electromagnetism -- a solenoid (illustration abbreviation) -- having -- **** -- this electromagnetism -- based on the driving signal from a control system 30 inputted to a solenoid, the fuel oil consumption and fuel injection timing of each [these] valves 21 and 26 are set up.

[0031] The supply pump 24 pressurizes high pressure and feeds the fuel usually fed from a feed pump 25 at the time of operation to the delivery pipe 22. Therefore, from the main-fuel injection valve 21, a high-pressure fuel is injected in a combustion chamber 14. On the other hand, in the time of engine starting, it is stopped by the pressurization of a fuel with this supply pump 24, and the fuel fed from a feed pump 25 comes to be supplied to the delivery pipe 22 through the pressurized room (illustration abbreviation) of this supply pump 24. Therefore, each fuel injection by the main-fuel injection valve 21 and the auxiliary fuel injection valve 26,comes to be performed based on fuel feeding by this feed pump 25.

[0032] moreover -- an engine 10 -- each -- the ignition plug 15 is formed corresponding to gas column #1-#4. The ignition plug 15 is connected to the ignitor 16 which builds in an ignition coil (illustration abbreviation), respectively, and the ignition timing is set up based on the ignition signal outputted to an ignitor 16 from a control system 30.

[0033] At the inhalation-of-air path 11, the throttle valve 17 which adjusts the amount of the inhalation air introduced in a combustion chamber 14 through this inhalation-of-air path 11 is formed in the upstream rather than the surge tank 12. The opening of this throttle valve 17 is adjusted by the throttle motor 18 controlled by the control system 30.

[0034] the electromagnetism of the main-fuel injection valve 21 by which the control system 30 of a fuel-injection control unit begins an electronic control 32, and drive control is carried out through this electronic control 32, and the auxiliary fuel injection valve 26 -- it has a solenoid, an ignitor 16, and the throttle motor 18, and is constituted.

[0035] An electronic control 32 is constituted by the output section 35 which outputs a driving signal to the operation part 33 which performs data processing, the storage section 34 the data referred to on the occasion of various control programs or activation of those are remembered to be, each above-mentioned fuel injection valves 21 and 26 (electromagnetism solenoid), etc., and input section as which detecting signal of various sensors is inputted 36 grade **.

[0036] Moreover, the starter 19 which drives the crankshaft (illustration abbreviation) of an engine 10 is connected to the output section 35 until self-sustaining of an engine 10 becomes possible at the time of engine starting. The starting operation (cranking) by this starter 19 is started when an ignition switch (illustration abbreviation) is switched to a starting location.

[0037] The detection system 40 of a fuel-injection control unit is equipped with the accelerator sensor 41, a coolant temperature sensor 42, the intake-pressure sensor 43, the throttle sensor 44, the rotational frequency sensor 45, and the gas column distinction sensor 46, and is constituted.

[0038] The accelerator sensor 41 is a sensor which is formed near the accelerator pedal 13 and detects the amount of treading in (accelerator opening ACCP), and a coolant temperature sensor 42 is a sensor which is formed in the engine water jacket (illustration abbreviation) of an engine 10, and detects the temperature (cooling water temperature THW) of engine cooling water. Moreover, the intake-pressure sensor 43 is a sensor which is formed in a surge tank 12 and detects the pressure (intake pressure PM) of the inhalation air in this tank 12, and the throttle sensor 44 is a sensor which detects the opening (throttle opening TA) of a throttle valve 17. All, the detecting signal of these sensors 41-44 is incorporated by operation part 33, after A/D (analog/digital) conversion is suitably carried out in the input section 36.

[0039] The rotational frequency sensor 45 is a sensor which is formed near the crankshaft (illustration abbreviation) and outputs the detecting signal according to the rotation, and the gas column distinction sensor 46 is a sensor which is formed near the cam shaft (illustration abbreviation) and outputs the detecting signal according to the rotation. All, the detecting signal of these sensors 45 and 46 is shaped in waveform in the input section 36, and is incorporated by operation part 33 as a pulse signal which synchronized with rotation of a crankshaft or a cam shaft, respectively. In operation part 33, the rotational speed (engine rotational speed NE) and the rotation phase angle (crank angle CA) of a crankshaft are computed based on these pulse signals, respectively.

[0040] Thus, the Lean-ized degree of a combustion air-fuel ratio is large at the time of engine starting, therefore when it is judged that there is a possibility that the flame in a combustion chamber 14 may light the gaseous mixture in the inhalation-of-air path 11, he is trying to control generating of a blowback by forbidding the fuel injection by the auxiliary fuel injection valve 26 in the fuel-injection control unit of this operation gestalt constituted.

[0041] Hereafter, drawing 2 and drawing 3 are combined, referred to and explained about the detail of the fuel-injection control concerning such this operation gestalt. Drawing 2 is a flow chart which shows the procedure at the time of computing the fuel oil consumption at the time of engine starting. a series of processings shown in this flow chart -- every predetermined crank angle (for example, 30-degreeCA (Crank Angle)) -- every -- as interrupt processing -- a control system 30 -- the operation part 33 of an electronic control 32 performs in detail.

[0042] First, on the occasion of this processing, it is judged whether it is at the engine starting time (step 110). This judgment is performed based on the comparison with the engine rotational speed NE and predetermined rotational speed (for example, 400rpm). And the engine rotational speed NE is more than predetermined rotational speed, and if judged with it not being at the engine starting time (step 110: NO), processing will once be ended. Based on the accelerator opening ACCP etc., the fuel oil consumption of the main-fuel injection valve 21 is determined through another manipulation routine incidentally in this case.

[0043] On the other hand, if judged with it being at the engine starting time (step 110: YES), based on the cooling water temperature THW, the charge injection quantity QINJST of cylinder internal combustion at the time of engine starting and the auxiliary fuel oil consumption QINJADD will be computed (step 120,130). Here, the above-mentioned charge injection quantity QINJST of cylinder internal combustion is the amount required at the time of engine starting of the fuel injected directly into a combustion chamber 14 from the main-fuel injection valve 21, and the auxiliary fuel oil consumption QINJADD is the amount required at the time of engine starting of the fuel injected in a surge tank 12 from the auxiliary fuel injection valve 26.

[0044] The relation between each [these] amounts required QINJST and QINJADD and the cooling water temperature THW is memorized by the storage section 34 of an electronic control 32 as a function map as shown in drawing 3 . If the auxiliary fuel oil consumption QINJADD decreases, so that the cooling water temperature THW becomes high and this cooling water temperature THW becomes beyond predetermined temperature as shown in this drawing, it will be set as "0." Therefore, fuel injection of the auxiliary fuel injection valve 26 will be performed only at the time of engine starting whose cooling water temperature THW is under predetermined temperature.

[0045] Next, it is judged whether the throttle opening TA is a degrees or more of predetermined opening (step 140). In this decision processing, if it puts whether there are more amounts of the inhalation air introduced in a combustion chamber 14 than the specified quantity in another way through the comparison with the throttle opening TA and a degrees of predetermined opening, it will be judged whether it is larger than the degree generating whose Lean-ized degree of a combustion air-fuel ratio is a blowback is expected to be.

[0046] Here, if it is judged that the throttle opening TA is a degrees or less of predetermined opening, therefore an inhalation air content is below the specified quantity (step 140: NO), this processing will once be ended. In this case, based on the charge injection quantity QINJST of cylinder internal combustion already set up as what a possibility that a blowback may occur does not have, and the auxiliary fuel oil consumption QINJADD, drive control of the main-fuel injection valve 21 and the auxiliary fuel injection valve 26 is carried out, respectively. Therefore, from each [these] fuel injection valves 21 and 26, the fuel of an amount equal to each above-mentioned amounts required QINJST and QINJADD comes to be injected in a combustion chamber 14 and a surge tank 12,

respectively.

[0047] Since there is a possibility that the Lean-ized degree of a combustion air-fuel ratio may be large, and a blowback may occur, on the other hand when the throttle opening TA is judged that there are more inhalation air contents than the specified quantity more greatly than a degrees of predetermined opening therefore (step 140: YES), it resets each above-mentioned amounts required QINJST and QINJADD (step 150,160). That is, the auxiliary fuel oil consumption QINJADD is added to the current charge injection quantity QINJST of cylinder internal combustion, and the aggregate value (= QINJST+QINJADD) is set up as new charge injection quantity QINJST of cylinder internal combustion (step 150). And the auxiliary fuel oil consumption QINJADD is set as "0" (step 160), and this processing is once ended. Therefore, in this case, while the fuel injection by the auxiliary fuel injection valve 26 is forbidden, from the main-fuel injection valve 21, the fuel of an amount only with more parts equivalent to the auxiliary fuel oil consumption QINJADD than original fuel-oil-consumption desired value (charge injection quantity QINJST of cylinder internal combustion) comes to be injected.

[0048] Thus, he is trying to supervise the Lean-ized degree of a combustion air-fuel ratio with this operation gestalt by judging some of amounts of the inhalation air introduced into a combustion chamber 14 based on the magnitude of the throttle opening TA. And when it is judged that there is a possibility that a blowback may occur from the Lean-ized degree of the combustion air-fuel ratio, he is trying to forbid the fuel injection by the auxiliary fuel injection valve 26.

[0049] (1) Therefore, in the inhalation-of-air path 11 of surge tank 12 grade, gaseous mixture is no longer generated and only inhalation air comes to flow this path 11. Consequently, even if the flame in a combustion chamber 14 may remain even in inside by combustion of gaseous mixture becoming slow in an inhalation-of-air line, generating of a blowback can be certainly controlled so that the flame may not light the gaseous mixture in the inhalation-of-air path 11.

[0050] Moreover, while forbidding the fuel injection of the auxiliary fuel injection valve 26 if it is in this operation gestalt although we are anxious about aggravation of engine startability if the fuel injection of the auxiliary fuel injection valve 26 is forbidden in this way, he is trying to increase the quantity of the fuel oil consumption (charge injection quantity QINJST of cylinder internal combustion) of the main-fuel injection valve 21.

[0051] (2) Therefore, aggravation of the engine startability accompanying the fuel injection of an auxiliary fuel injection valve being forbidden can be controlled now as much as possible. Moreover, with this operation gestalt, although he is trying to presume an inhalation air content based on the throttle opening TA, this inhalation air content can also be presumed based on the intake air flow detected in this meter, when this is presumed based on an intake pressure PM and the engine rotational speed NE or it has an air flow meter.

[0052] However, since fluctuation of an intake pressure PM, the engine rotational speed NE, and an intake air flow becomes large at the time of engine starting, also when an

inhalation air content is usually presumed based on such a parameter, for example it is originally in the condition that the fuel injection of an auxiliary fuel injection valve should be forbidden, there is concern to which this fuel injection will be permitted by reduction of a temporary inhalation air content.

[0053] (3) According to this point and this operation gestalt, an inhalation air content comes to be presumed as an average value which removed a part for that fluctuation, and since it is determined whether forbid the fuel injection of an auxiliary fuel injection valve based on that estimate, generating of a blowback can be controlled more certainly.

[0054] [The 2nd operation gestalt], next the 2nd operation gestalt of this invention are explained focusing on difference with the operation gestalt of the above 1st.

[0055] He is trying to set each [these] injection quantity QINJST and QINJADD as a suitable value with this operation gestalt, by dividing into the above-mentioned charge injection quantity QINJST of cylinder internal combustion, and the auxiliary fuel oil consumption QINJADD the total amount (the total fuel oil consumption QTOTAL) of the fuel oil consumption needed for engine starting according to the split ratio k set up based on the accelerator opening ACCP etc., when controlling generating of a blowback, and aggravation of engine startability, respectively.

[0056] Hereafter, drawing 4 and drawing 5 are combined, referred to and explained about the detail of the fuel-injection control concerning such this operation gestalt. Drawing 4 is a flow chart which shows the procedure at the time of computing the fuel oil consumption at the time of engine starting. a series of processings shown in this flow chart -- as interrupt processing for every (every [for example,] 30-degreeCA) predetermined crank angle -- a control system 30 -- the operation part 33 of an electronic control 32 performs in detail.

[0057] First, on the occasion of this processing, it is judged based on the engine rotational speed NE whether it is at the engine starting time (step 210). And if judged with it not being at the engine starting time (step 210: NO), processing will once be ended and the fuel oil consumption of the main-fuel injection valve 21 will be determined through another manipulation routine.

[0058] On the other hand, if judged with it being at the engine starting time (step 210: YES), the total fuel oil consumption QTOTAL will be computed based on the cooling water temperature THW (step 220). Next, based on the cooling water temperature THW and the accelerator opening ACCP, split ratio k ($0<=k<1.0$) is computed (step 230).

[0059] This split ratio k determines the rate of the auxiliary fuel oil consumption QINJADD to the total fuel oil consumption QTOTAL. When the auxiliary fuel oil consumption QINJADD increases and the isomerism rate ratio k is set as "0" so that this split ratio k is set up greatly, when the total fuel oil consumption QTOTAL is set constant, the fuel injection of the auxiliary fuel injection valve 26 will be suspended.

[0060] Moreover, the relation between this split ratio k, the cooling water temperature THW, and the accelerator opening ACCP is memorized by the storage section 34 of an electronic control 32 as a function map as shown in drawing 5 . As shown in this drawing,

this split ratio k is set as a large value, so that the cooling water temperature THW becomes low, when the accelerator opening ACCP is set constant. Therefore, the rate of the fuel injected from the auxiliary fuel injection valve 26 comes to increase, so that the cooling water temperature THW becomes low.

[0061] Furthermore, split ratio k is set as such a small value that the accelerator opening ACCP becomes large, when the cooling water temperature THW is set constant. Therefore, the rate of the fuel injected from the auxiliary fuel injection valve 26 comes to decrease, so that the accelerator opening ACCP becomes large.

[0062] Here, the accelerator opening ACCP is used for the decision of split ratio k as what has the inhalation air content which changes according to the throttle opening TA and this throttle opening TA, and correlation. That is, since the throttle opening TA becomes large so that this accelerator opening ACCP becomes large, it can be judged that there are more inhalation air contents. For this reason, by determining split ratio k based on the accelerator opening ACCP as mentioned above, the rate of the fuel injected from the auxiliary fuel injection valve 26 comes to decrease, so that an inhalation air content increases and the Lean-ized degree of a combustion air-fuel ratio becomes large.

[0063] In this way, if split ratio k is determined, according to the following operation expression (1) and (2), the auxiliary fuel oil consumption QINJADD and the charge injection quantity QINJST of cylinder internal combustion will be computed, respectively (step 240,250), and processing will once be ended.

[0064]

QINJADD=QTOTALxk ... (formula 1)

QINJST=QTOTAL-QINJADD ... (formula 2)

When the value of the auxiliary fuel oil consumption QINJADD at the time of making accelerator opening ACCP into "0 degree" and the charge injection quantity QINJST of cylinder internal combustion is made into each reference value QINJADDK and QINJSTK so that clearly from the function map shown in each above-mentioned operation expression (1), (2), and drawing 5 , according to the accelerator opening ACCP, the quantity of the auxiliary fuel oil consumption QINJADD will be decreased from the reference value QINJADDK, and the loss-in-quantity degree **QINJADD will be set up so greatly that this accelerator opening ACCP becomes large.

[0065] On the other hand, according to the accelerator opening ACCP, the quantity of the charge injection quantity QINJST of cylinder internal combustion will be increased from the reference value QINJSTK, and the increase-in-quantity degree **QINJST will be set up so greatly that loss-in-quantity degree **QINJADD of the auxiliary fuel oil consumption QINJADD will become large if it puts in another way so that this accelerator opening ACCP becomes large.

[0066] Therefore, the fuel concentration of the gaseous mixture generated in the inhalation-of-air path 11 comes to be stopped, and the fall of the engine startability accompanying loss in quantity of the auxiliary fuel oil consumption QINJADD comes to be suitably compensated by increase in quantity of the charge injection quantity QINJST of

cylinder internal combustion, so that an inhalation air content increases, the Lean-ized degree of a combustion air-fuel ratio becomes large and the rate of combustion of the gaseous mixture in this combustion chamber 14 falls.

[0067] Therefore, according to this operation gestalt, in addition to the operation effectiveness indicated to (1) and (2) in the operation gestalt of the above 1st, generating of (4) blowbacks and aggravation of engine startability can be further controlled now appropriately, respectively.

[0068] Moreover, since he is trying to presume the inhalation air content at the time of engine starting based on the accelerator opening ACCP, this inhalation air content comes to be presumed as an average value which removed a part for the fluctuation. Therefore, the operation effectiveness equivalent to (3) indicated in the 1st operation gestalt also according to this operation gestalt can be done so.

[0069] [The 3rd operation gestalt], next the 3rd operation gestalt of this invention are explained focusing on difference with the operation gestalt of the above 1st.

[0070] When there is a possibility that a blowback may occur, he is trying to control generating of a blowback with this operation gestalt by forbidding the starting operation by the starter 19 and forbidding substantially the fuel injection of the both sides of the main-fuel injection valve 21 and the auxiliary fuel injection valve 26.

[0071] Hereafter, the detail of the engine starting control in such this operation gestalt is explained. Drawing 6 is a flow chart which shows the procedure at the time of operating a starter 19 at the time of engine starting. a series of processings shown in this flow chart -- as interrupt processing for every predetermined time -- a control system 30 -- the operation part 33 of an electronic control 32 performs in detail.

[0072] In this processing, it is judged first whether it is the no by which the ignition switch is switched to the starting location (step 310). And when an ignition switch is in a starting location, (step 310:YES) and the engine rotational speed NE are measured with the predetermined rotational speed TNE (step 320), and when the engine rotational speed NE is below the predetermined rotational speed TNE, the cooling water temperature THW is further compared with the predetermined judging temperature TTHW as what (step 320:YES) and engine starting have not completed (step 330). This predetermined judging temperature TTHW will be a decision value for judging whether fuel injection of the auxiliary fuel injection valve 26 is performed, if it puts whether the fuel-oil-consumption desired value (equivalent to the above-mentioned auxiliary fuel oil consumption QINJADD) of the auxiliary fuel injection valve 26 is more than "0" in another way.

[0073] And if it is judged with that by which fuel injection by (step 330:YES) and the auxiliary fuel injection valve 26 is performed and puts continuously whether the accelerator opening ACCP is "0 degree" in another way when the cooling water temperature THW is below the predetermined judging temperature TTHW, it will be judged whether the throttle opening TA is set up more than idle opening, and it is in the condition that the inhalation air more than the specified quantity is introduced in a combustion chamber 14 (step 340).

[0074] And when the accelerator opening ACCP is not "0 degree", the (step 340:NO) starting authorization flag XSTRT is set as "OFF" (step 355). Moreover, when there is no ignition switch in a starting location (step 310: NO), or when the engine rotational speed NE is larger than the predetermined rotational speed TNE (step 320: NO), the starting authorization flag XSTRT is similarly set as "OFF" (step 355).

[0075] On the other hand, when the cooling water temperature THW is higher than the predetermined judging temperature TTHW (step 330: NO), or when the accelerator opening ACCP is "0 degree" (step 340: YES), the starting authorization flag XSTRT is set as "ON" by each (step 350).

[0076] Next, it is judged whether the starting authorization flag XSTRT is "ON" (step 360), when this flag XSTRT is "ON" (step 360: YES), the starting operation by the starter 19 is started (step 370), when this flag XSTRT is "OFF" (step 360: NO), starting operation by the starter 19 is suspended (prohibition) (step 380), and processing is once ended.

[0077] Thus, if according to this operation gestalt the throttle valve 17 is opened by treading in of an accelerator pedal 13 more than idle opening and fuel injection by the auxiliary fuel injection valve 26 is performed, when it will be judged that there is a possibility that a blowback may occur, he is trying to forbid the starting operation by the starter 19. Therefore, since the fuel injection of the both sides of the main-fuel injection valve 21 and the auxiliary fuel injection valve 26 will also be forbidden substantially, generating of a blowback can be prevented certainly.

[0078] Moreover, even if it forbids only the fuel injection of the auxiliary fuel injection valve 26 unlike this operation gestalt, about generating of a blowback, this can be controlled certainly here. However, if the fuel injection of the auxiliary fuel injection valve 26 is forbidden in this way and only the fuel injection of the main-fuel injection valve 21 is made to perform engine starting, engine startability will come to fall. Consequently, while the fuel injected from the main-fuel injection valve 21 has not burned without completing starting, it may adhere to the wall surface of a combustion chamber 14. For this reason, in redoing starting, the combustion air-fuel ratio in a combustion chamber 14 becomes rich too much by evaporation of the fuel which adhered to the wall surface of an engine combustion chamber at the time of the last starting, and there is a possibility that the engine startability at the time of starting of such redo may get worse.

[0079] With this point and this operation gestalt, after engine startability has got worse as mentioned above, fuel injection is performed, and if a lot of fuels do not adhere to the wall surface of a combustion chamber 14 and treading in of an accelerator pedal 13 is canceled, an engine 10 can be started promptly.

[0080] (5) Therefore, according to this operation gestalt, aggravation of the engine startability at the time of starting of the above redo can be controlled now.

Each operation gestalt explained beyond [other operation gestalten] can also change and carry out a configuration as follows.

[0081] · Although the fuel injection of the auxiliary fuel injection valve 26 was forbidden with the 1st operation gestalt when the throttle opening TA was a degrees or more of

predetermined opening, you may make it decrease the quantity of the fuel oil consumption (auxiliary fuel oil consumption QINJADD) of this auxiliary fuel injection valve 26. Moreover, you may make it set up greatly the loss-in-quantity degree of the auxiliary fuel oil consumption QINJADD on the occasion of the loss in quantity, so that the throttle opening TA becomes large. Furthermore, you may make it increase the quantity of the fuel oil consumption of the main-fuel injection valve 21 according to the loss-in-quantity degree.

[0082] - Although the Lean-ized degree of a combustion air-fuel ratio was supervised through the comparison with the throttle opening TA and a degrees of predetermined opening, it has the amount of inhalation air and correlation which are introduced into the combustion chambers 14, such as an inhalation air content computed from an intake pressure PM and the engine rotational speed NE, and the accelerator opening ACCP, an intake pressure PM, for example, and you may make it supervise a ** Lean-ized degree with the 1st operation gestalt based on a variable parameter. Moreover, when it considers as a configuration equipped with an air flow meter, such a Lean-ized degree can also be supervised based on the intake air flow detected in this meter.

[0083] - Although the above-mentioned split ratio k was computed based on the accelerator opening ACCP besides the cooling water temperature THW, it replaces with the accelerator opening ACCP and you may make it compute the isomerism rate ratio k with the 2nd operation gestalt based on the throttle opening TA. Moreover, it has the inhalation air content computed from an intake pressure PM and the engine rotational speed NE in the isomerism rate ratio k, the amount of the inhalation air introduced into the combustion chambers 14, such as an intake pressure PM, and correlation, and you may make it compute based on a variable parameter.

[0084] - Although generating of a blowback was controlled with each above-mentioned operation gestalt by forbidding the fuel injection of the auxiliary fuel injection valve 26, or decreasing the quantity of the fuel oil consumption (auxiliary fuel oil consumption QINJADD), you may make it control the generating still more certainly by combining with this and changing ignition timing at the stage by the side of a tooth lead angle.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] The outline block diagram showing the whole fuel-injection control unit configuration concerning this invention.

[Drawing 2] The flow chart which shows the calculation procedure of fuel oil consumption at the time of starting of the 1st operation gestalt.

[Drawing 3] The function map in which the relation between the charge injection quantity of cylinder internal combustion and auxiliary fuel oil consumption, and cooling water temperature is shown.

[Drawing 4] The flow chart which shows the calculation procedure of fuel oil consumption at the time of starting of the 2nd operation gestalt.

[Drawing 5] The function map in which the relation between the split ratio for determining auxiliary fuel oil consumption, cooling water temperature, and accelerator opening is shown.

[Drawing 6] The flow chart which shows the procedure about engine starting processing of the 3rd operation gestalt.

[Description of Notations]

10 [-- Accelerator pedal,] -- An engine, 11 -- An inhalation-of-air path, 12 -- A surge tank, 13 14 [-- Throttle valve,] -- A combustion chamber, 15 -- An ignition plug, 16 -- An ignitor, 17 18 [-- Main-fuel injection valve,] -- A throttle motor, 19 -- A starter, 20 -- A fuel-supply system, 21 22 -- A delivery pipe, 23 -- A fuel tank, 24 -- Supply pump, 25 [-- Electronic control,] -- A feed pump, 26 -- An auxiliary fuel injection valve, 30 -- A control system, 32 33 [-- The input section 40 / -- A detection system, 41 / -- An accelerator sensor, 42 / -- A coolant temperature sensor, 43 / -- An intake-pressure sensor, 44 / -- A throttle sensor, 45 / -- A rotational frequency sensor, 46 / -- A gas column distinction sensor, #1-#4 / -- Gas column.] -- Operation part, 34 -- The storage section, 35 -- The output section, 36